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Effect of Lower Torso Training in Chronic Obstructive Pulmonary Disease Patients

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Abstract:

This study was developed to investigate the influence of lower torso muscle training on 6-min walk distance (6MWD) in patients with COPD.
Design: An experimental study.
Setting: Morjan Hospital.
Patients: Thirty patients with moderate COPD were estimated.
Measurements and results: Pulmonary function and baseline dyspnea index (BDI) were assessed, maximal inspiratory pressure (PI, max), and 6MWD were measured, and the one minute repeat was determined for each of two exercises (leg extension, and leg press) performed on gymnasium equipment. Quality of life was estimated using the St. George Respiratory Questionnaire (SGRQ). The researchers found statistically important positive effects for training program on 6MWD and body weight (r _ 0.32; $p < 0.05$), BDI (r _ 0.50;$p < 0.01$), FEV1 (r _ 0.33; $p < 0.05$), PI, max (r _ 0.53; $p < 0.01$).
Conclusions: The results of this study showed the importance of the lower torso training in submaximal exercise tolerance and could open new perspectives for training programs designed to improve functional activity in COPD patients.

Key words: Lower-torso muscles; 6-min walk distance; COPD.

1. Introduction:

Testing the ability of a patient to walk as far as possible for a 6 min is easy objective, reliable and inexpensive instrument used to evaluate submaximal exercise capability and functional activity. The 6-minwalk test (6MWT) may point to the capacity to perform the daily life activities and can be carried out by elderly persons and those with severe conditions like COPD or heart failure.

The test is achieved in a corridor without developed equipment and does not require highly qualified staff, the intensity of the 6MWT is self-determined and the test has been undertaken by thousands of people, including patients with cardiovascular disease without adverse effects in COPD patients, the 6-min walk distance(6MWD), part of a multidimensional scale known as the bode index, expects mortality better than do other traditional indicators of disease severity, such as FEV1 in patients with severe diseases, reductions in 6MWD occurred independently of changes in FEV1,whereas FEV1 is the most probable marker of respiratory system including in COPD, the 6MWD possibly reflects the systemic effects of the disease.

The 6MWD should be involved in COPD patient estimation, and its determining aspects should be carefully explained. Several aspects may influence the 6MWD in healthy persons and in COPD patients, mental health, age, body weight, and comorbidities can affect the test results in elderly persons, the sensation of dyspnea and poor nutritional state are indexes of COPD that can also decrease 6MWD. Muscle endurance in the lower limbs has previously been shown to be animportant factor in determining the 6MWD (Palange, 2003), however, data concerning the influence of lower torso on 6MWD is rare and limited to those found from studies evaluating handgrip endurance and maximal inspiratory pressure (Pimax).

The researchers found only one study that estimated the effect of the large chest muscles and upper-limb muscles on maximum exercise capacity in patients with pulmonary diseases, and the researchers were unable to find any studies assessing the influence of lower torso muscles on 6MWD, also there is no study has investigated the effect of limp muscle endurance on 6MWD, so the researchers see that this project is very important for patients with COPD to help them to be more better. Therefore, the hypothesis of this study is that lower torso muscle endurance may affect 6MWD in COPD patients.

To test our hypothesis, we investigated the effect of lower torso muscle endurance on 6MWD in COPD patients. The researchers also estimated the influence of other aspects known to impede the 6WMD, such as age, pulmonary function, nutritional state, sensation of dyspnea, and lower-limb muscle endurance.

In conclusion, the importance of current study is to know the effect of training of lower torso muscles endurance to 6MWD in patients with COPD.

2. Methodology:

Thirty COPD patients repeatedly admitted to a pulmonary rehabilitation center were evaluated. Patients were included if they fulfilled the criteria for COPD according to the Global Initiative for COPD guidelines (Global Initiative for COPD guidelines, 2008). FEV1/FVC ratio <60%, Patients were included in the study only when in a clinically stable condition with no history of infections or exacerbation of respiratory indications, no alterations in medication within the 2 months previous the study outset, and no clinical marks of edema. Patients presenting with evidence of cardiovascular or osteoarticular damage were excluded. All patients were made aware of the proposed study procedures and freely gave written informed agreement, table (1) shows baseline characteristics of the study population.

Table (1)
Baseline Characteristics of the Study Population

Variables	Mean	SD
Age, yr	62.86	8.82
Weight, kg	69.61	14.67
FEV1, % of predicted	57.00	22.14
Pao2, mm Hg	73.01	9.49
Spo2, %	94.07	2.58
BMI, kg/m2	24.04	3.70
LBM, kg	48.22	7.48

LBMI, kg/m2	16.02	3.00
BDI	1.80	1.14
Total SGRQ score	% 49.36	17.55
Pimax, cm H2O	_ 68.00	23.00
Bench press, 1 min in kg	32.71	8.77
Lat pull down, 1 min in kg	38.00	9.00
Leg extension, 1 min in kg	29.00	9.00
Leg press, 1 min in kg	82.15	26.42
6MWD, m	540.00	92.00

2.1 Testing Procedures:

The researcher did number of tests as below explain.

2.1.1 Pulmonary Function:

Pulmonary function and reversibility tests were achieved with a spirometer (type German), according to the criteria set by the American Thoracic Society (American Thoracic Society, 2002). Values of FEV1 are stated in liters, in percentages of FVC, and as percentages of reference values.

2.1.2 Nutritional evaluation:

Height and body weight were measured, and body mass index (BMI) [weight/height squared] was calculated. Resistance was measured on the right side of the body in the flat position in accordance with the method described by Lukaski (1987). Lean body mass (LBM) was calculated in kilograms using a group-specific regression equation developed by Kyle et al (1998). The LBM index (LBMI) [LBM/height squared] was also calculated.

2.1.3 Quality of life and baseline dyspnea:

A version of the St. George Respiratory Questionnaire (SGRQ) validated for application in Iraq was used to assess patient quality of life (QoL) (Jones, et al., 1992). A similarly modified version of the baseline dyspnea index (BDI) developed by Mahler et al (1984) was used to estimate baseline dyspnea.

2.1.4 Respiratory pressures and Peripheral muscle endurance:

The researchers measured PImax and maximal expiratory pressure PEmax in accordance with Black and Hyatt (1969). Peripheral muscle endurance was assessed through repeated maximal grip movements (1-min bouts) (Capodaglio 1997). The arranged rule for 1 min bouts is the normal weight that can be lifted throughout the complete range of determined movement. The 1 min repeat was assessed for each of four exercises achieved on gymnasium equipment. Patients were required to perform the following exercises: lat pull down (latissimusdorsi, trapezius, rhomboids, bench press (pectorals and triceps), leg extension (quadriceps), and leg press (quadriceps, gluteus, hamstrings, and calf muscles). A warm up of 12 repetitions with a light weight was achieved prior to the test so as to reduce the effects of learning. All participants attained the 1 min within two attempts. One to 2 min of rest was allowed between repetitions. The Valsalva maneuver was avoided, and the correct exercise performance technique for each muscle group was emphasized.

2.1.5 6MWDT

The researchers conducted the 6MWD according to American Thoracic Society guidelines (American Thoracic Society statement-European Respiratory Society, 2002), patients were instructed to walk, attempting to cover as much ground as possible within 6 min. A research assistant timed the walk, and standardized verbal encouragement was given to each patient, data were obtained for Spo2, heart rate, respiratory rate, Borg scale dyspnea score, and BP before and after the test. The distance covered was measured in meters.

2.2 Statistical analysis:

To study the relationship between changes, Pearson or spearman coefficients of relationship were used with the level of statistical significance set at 5%. Data were submitted to multiple regression analysis to evaluate independent variables that might be determinants of 6MWD. For variables with associations <0.70 or > 0.70, the researchers selected those with the greatest clinical relevance. As body composition parameters, BMI, and the LBMI were selected, whereas FEV1 and Spo2 were chosen as parameters of pulmonary function. The 6MWD was defined as a dependent variable.

3. Results and Discussion

Table (2)
shows Mean, SD, T-test, signal, and Significant of Pre and post-tests for Study population

Variables	Pre-test		Post-test		T-test		Significant
	Mean	SD	Mean	SD	Accountable	Signal	
Weight	69.21	14.76	72.13	10.31	2.11	00.00	S
BDI	22.03	3.70	24.87	2.54	6.07	0.005	S
FEV1, % of predicted	40.16	22.91	50.02	14.28	5.43	0.000	S
Pimax	58.00	9.01	60.23	10.71	3.12	0.000	S
Leg press	3.12	1.3	4.6	0.14	2.7	0.000	S
Leg extension	2.3	0.45	3.6	0.2	3.01	0.003	S
BorgF-6MWT	1.80	1.03	1.01	0.27	3.6	0.005	S
Spo2	92.37	7.40	95.68	8.24	7.52	0.000	S
6 MWD	540	92.60	580	90.02	4.91	0.003	S
Total SGRQ score	49.23	7.34	53.26	9.71	4.78	0.004	S

Size of study population (30), and significant level (0.05)

Results of this study recommended for the first time that lower muscle endurance is a predictor of 6MWD in COPD patients. Our results also confirm the effect of maximum inspiratory pressure (Pimax), dyspnea, and body weight on the 6MWD of these patients. Multiple regression analysis discovered that Pimax, BDI, and body weight were accountable for 63.8% of the total 6MWD difference.

Data in literature regarding the effect of lower torso muscle endurance on 6MWD are related to Pimax. The results of this study support previous findings with COPD patients (Decramer et al., 2010, TenVergert et al., 2007) indicating the influence of Pimax on 6MWD. TenVergert evaluated the effect that pulmonary function, Pimax, QoL, and sensation of dyspnea had on the exercise capacity of 40 patients with severe to very severe COPD and determined that Pimax and diffusing capacity explained 54% of the total variance in 6MWD. Decramer et al., (2010) also reported that Pimax influenced submaximal exercise capacity in COPD patients.

Although Pimax reflects the pressure created by the inspiratory muscles, its measurement is affected by other aspects such as passive elastic recoil pressure of the respiratory system, including the lungs and chest wall (American Thoracic Society-European Respiratory Society, 2002). In addition, estimation of accessory respiratory muscle endurance using a procedure unaffected by lung volume and elastic recoil could provide additional information about the influence of these muscles on 6MWD.

The influence of lower muscle endurance on 6MWD found in the present study has not been before described in the literature. Killian et al (2011) evaluated the influence of thoracic and upper limb muscle endurance on the maximal exercise capacity of patients with respiratory disease; however, the authors did not estimate 6MWD. Nevertheless, the influence of lower-limb peripheral muscle function on exercise capacity in COPD patients has been described by a number of authors such as (Leblanc et al., 2005). There are extensive data indicating that lower-limb muscle endurance is reduced and upper-limb endurance is fairly conserved in COPD patients, and it has been established that these muscles have a clear relationship to walking. This may explain the large number of studies estimate the influence of lower-limb muscle endurance, rather than that of thoracic and upper-limb muscle endurance, on exercise capacity in such patients.

The influence of lower muscle endurance on 6MWD might be explained by the large number of accessory respiratory muscles involved in performing the lat pull down exercise. Muscles necessary to accomplish the exercise involve the latissimusdorsi, trapezius, rhomboids, pectorals major, and biceps (Delavier, 2002). Some of these muscles may believe an accessory respiratory function when the main respiratory muscles are dysfunctional or cannot meet the ventilator require (Epstein, 1994).

This is in covenant with previous studies (Enright, et al., 2003), showed a significant positive effective of lower muslces endurance on 6MWD in COPD patients, and designating this specific muscular endurance as a predictor for 6MWD in healthy elderly individuals. Since lower limb endurance is a direct measure of skeletal muscle endurance of the leg and distal lower-torso muscles, our data support the declaration that lower-torso muscle endurance influences walking distance.

Another indicator that systemic manifestations of COPD affected exercise capacity in our study was the identification of body weight as a predictor of 6MWD. Our results showed a statistically significant positive effective of body weight on 6MWD, in keeping with data in the literature (Forte, et al., 2009).

Enright et al., 2003 showed that underweight, overweight, and obese patients walked shorter distances than did eutrophic individuals. Low body weight is often correlated to loss of LBM and reduced muscle endurance. In addition, obesity rises the energy expended at a given exercise intensity. Therefore, either situation

may result in a reduced capacity to walk longer distances, In our patients, the baseline sensation of dyspnea, as assessed by the BDI, was also determined to be a predictor of 6MWD, as has been previously demonstrated (Kirsten et al.,2007). Kirsten et al observed that the most important determinants of 6MWD involved the scores from three different instruments devised to measure dyspnea, as well as the dyspnea domain of the Chronic Respiratory Disease Questionnaire.

Similarly, Nishimura et al., 2002 presented that the sensation of dyspnea was a determinant of maximum oxygen uptake, 6MWD, and endurance time in COPD patients. In fact, it has been exposed that the sensation of dyspnea is one of the most significant factors in determining the general health status of COPD patients, and that it effects QoL as assessed through the use of general and respiratory disease specific mechanisms (Faryniarz et al., 2006).

The researchers found a statistically significant effect of training of lower torso on 6MWD and QoL, as determined by the SGRQ activity domain, total score. In a study of Antunes et al., 2004 estimating 6MWD, pulmonary function, peripheral muscle endurance, respiratory muscle endurance, and body composition, 6MWD was recognized as a determinant of the SGRQ activity and influence domains. Other study Schlosser et al., 2007 has also observed a statistically important correlation between exercise capacity and QoL indicators in COPD patients. These discoveries suggest that exercise capacity is an significant determinant of QoL in COPD patients, and that the inverse is not true, there is significant indication that lower-limb muscle endurance effect maximal and submaximal exercise capacity in healthy individuals and in COPD patients, and various treatments for this condition have been showed (LeBlanc et al., 2008).

4. Conclusion:

The effect of lower-torso muscle endurance seen in our study does essentially suggest a causal effect. Further studies will be required so as to estimate the effect of interventions including specific muscle reconditioning on submaximal exercise capacity in COPD patients. The most effective component of pulmonary rehabilitation is related to physical conditioning. Therefore, endurance training with free weights is a possible option for muscle overhauling in COPD patients. Actually, a number of studies (Whittom et al., 2010, Troosters et al., 2011) have estimated the effects of endurance training in COPD patients and have showed improvements in QoL and 6MWD.

The results of this study highlight the importance of the skeletal musculature in exercise capacity in COPD patients. Body weight, peripheral muscle endurance, respiratory muscle endurance, and the sensation of dyspnea all have an effect on the capacity of COPD patients to achieve exercises. Therefore, there is a real need to develop treatment strategies that while taking into account individual objectives and requirements, are aimed at interrupting the dyspnea, dyspnea cycle, sedentary lifestyle in these patients.

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